Technical Specifications

Overview

Appendix A provides the technical specifications for the Cisco 12404 Internet router, and procedures for repackaging the router.

- Product Architecture, page A-2
- Fan Tray Assembly, page A-25
- Air Filter, page A-27
- Chassis Cable-Management System, page A-28
- Maintenance Bus, page A-28

This appendix includes the following environmental specifications.

- Temperature, humidity, and altitude ranges
- Operating and storing the product
- Memory requirements
- Physical characteristics
- Dimensions and weight
- Power supply characteristics
- Output capacity
- Power dissipation
- Heat dissipation

- Voltage frequency
- Listing agency approvals

Product Architecture

Table A-1 lists system level requirements for the Cisco 12404 Internet router.

Table A-1 Cisco 12404 Internet Router Product Architecture

Feature	Description
Slot Capacity	4 slots 3 OC192 capable I/O slots 1 RP slot that is 10G capable 1 CSF/alarm card
Chassis	One card cage with five slots, three OC192 pitch slots, one RP slot and one CSF slot
Height	Not to exceed 8.75 inches; supports 8 systems per 7 ft. rack
Width	19 inch rack mountable
Depth	27.85 in. (70.74 cm) maximum
Switching Capacity	10 Gbps full-duplex switching capacity per slot. This includes the RP slots. Each slot capable of supporting all current and future Engine 0, Engine 1, Engine 2, Engine 3 and Engine 4 based line cards. Specific interfaces include OC192c, QOC48c, 10GE, 10x1GE, etc, 3xGE, 1xGE, 8xFE and other 10GiG cards. The switching capacity is required to handle all four 10GiG capable slots (including RP), thus the total switching capacity will be 80 Gbps full-duplex
Cooling	Side-to-side cooling
Power Supplies	110V AC 220V AC DC (optional)

Table A-1 Cisco 12404 Internet Router Product Architecture (continued)

Feature	Description
Power Requirements	110V AC power, sufficient to handle three OC192c /10GE capable line cards and one 10G capable RP. Total power supplied to the system should not exceed 1200VA Two AC or DC power supplies in redundant configuration should be able to support the entire power needs of the chassis.
Power Supply Redundancy	Redundant and load sharing AC power entry module (PEMs), or Redundant and load sharing DC PEMs and DC power distribution units (PDUs)
Route Processors	Supports up to 2 RPs per system The second RP can be used in any slot[1] The first RP is inserted in slot 0 (1.25 inch height) see Figure A-4
Route Processor Redundancy	Supports online insertion and removal, hot swappable RP redundancy
Switch Fabric	The switch fabric supports up to 80 Gbps of capacity
NEBS	The Cisco 12404 Inernet Router is designed to comply with NEBS Level 3 certification

1. A narrow card filler panel must be used to ensure proper air flow through the chassis and electromagnetic compatibility (EMC)

Specifications

Table A-2 lists Cisco 12404 Internet router physical specifications. Table A-3 lists the environmental specifications.

Table A-2 Cisco 12404 Internet Router Physical Specifications

Description	Value
Frame height	8.75 inches (22.2 cm)
Frame width	19 inches (48.3 cm)
Frame depth	26 inches (66.0 cm)
Weight Maximum configuration Minimum configuration	 103 pounds (46.7 kg) 73 pounds (33.1 kg) (without line cards)

Table A-3 Cisco 12404 Internet Router Environmental Requirements

Environmental Requirements	Ranges
Temperature	32 to 104F (0 to 40 C) operating -4 to 149F (-20 to 65 C) non-operating -5 to 133F (-23 to 55 C) Max operating for 96 hrs. only
Humidity	10 to 90% non-condensing operating 5 to 95% non-condensing non-operating
Altitude	0 to 10,000 ft. (0 to 3,050 m) operating 0 to 30,000 ft. (0 to 9,144 m) non-operating
Heat dissipation	3,343 Btu/hr. maximum
Cooling	Facing the router, right side-to-side cooling
Shock	5 to 500 Hz, 0.5g (0.1 oct/min[1]) operating 5 to 100Hz, 1g (0.1 oct/min) non-operating 100 to 500Hz, 15g (0.2 oct/min) 500 to 1,000Hz, 1.5g (0.2 oct/min)

1. oct/min = Octave per minute

Warning **Exhaust from other equipment vented directly into the Cisco 12404 Internet router air inlet may cause an over-heat condition. Install the router so that it is protected from a direct flow of hot air from other equipment.**

AC-Powered Routers

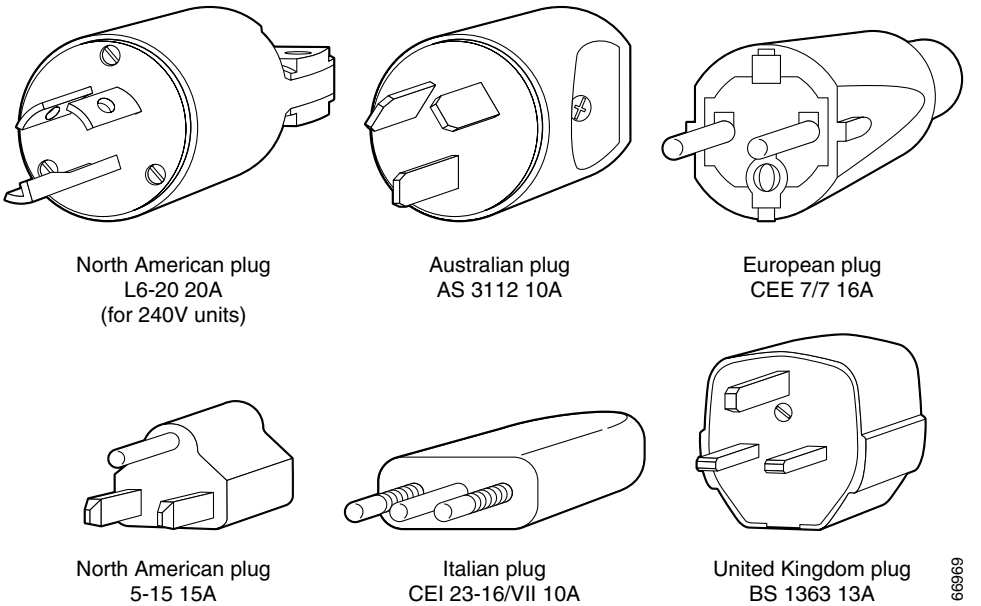
At sites where the Cisco 12404 router operates with AC PEMs, observe the following guidelines.

- A power factor corrector (PFC) allows the PEM to accept AC power source voltage from an AC power source operating between 100–120 VAC, 15–Amp service in North America; and a range of 185–264 VAC, 10–Amp service, in an international environment.
- All AC PEM power cords measure 14 feet (4.3 meters).
- Provide a dedicated power source for each PEM installed in the router.
- Install an uninterruptable power source where possible.

AC Power Plugs

Different styles of AC input power cords are shown in Figure A-1.

Figure A-1 AC Power Plugs



Route Processor

Each Cisco 12404 Internet router has one main system (or route) processor. The route processor (RP) processes the network routing protocols and distributes updates to the Cisco Express Forwarding (CEF) tables on the line cards. The RP also performs general maintenance functions, such as diagnostics, console support, and line card monitoring.

Two types of RPs are available for the Cisco 12404 Internet router:

- Gigabit Route Processor (GRP)
- Performance Route Processor (PRP)

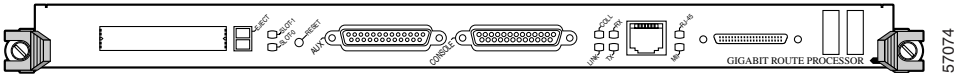
Gigabit Route Processor

This section provides an overview of the GRP (Figure A-2) and its use as the main system processor for the Cisco 12404 Internet router.

This section provides information on the following GRP functionality.

- GRP memory
- System status LEDs
- Soft reset switch
- PCMCIA slots
- Asynchronous serial ports

Figure A-2 Gigabit Route Processor



The following are primary functions of the GRP.

- Loading the Cisco IOS software to all of the installed line cards at power on
- Providing a console (terminal) port for router configuration
- Providing an auxiliary port for other external equipment (such as modems)
- Providing an IEEE 802.3, 10/100-megabit-per-second (Mbps) Ethernet port for Telnet functionality
- Running routing protocols
- Building and distributing routing tables to the line cards
- Providing general system maintenance functions for the router

The GRP communicates with the line cards either through the CSF or through the maintenance bus (MBus). The CSF connection is the main data path for routing table distribution as well as for packets that are sent between the line cards and the GRP.

The MBus connection allows the GRP to download a system bootstrap image, collect or load diagnostic information, and perform general, internal system maintenance operations. The GRP plugs into any slot in the card cage in the Cisco 12404 Internet router. The router is shipped with 20MB of Flash memory as the default configuration.

GRP Memory

Memory components of the GRP are listed in Table A-4.

Table A-4 GRP Memory Components

Type	Size	Quantity	Description
DRAM	64[1] to 256 MB	1 or 2	64- or 128-MB DIMMs (based on DRAM required) for main Cisco IOS software functions.
DIMM			3.3-volt, 60 nanosecond device
SRAM	512 KB (fixed)[2]		SRAM for secondary CPU cache memory functions.
NVRAM	512 KB (fixed)[3]		Nonvolatile random-access memory (NVRAM) for the system configuration file.
Flash Memory (SIMM)[4]	8 MB	1	Contains Cisco IOS software images and other user-defined files on the GRP.
Flash Memory (card)	20 MB[5]	Up to 2	Contains Cisco IOS software images and other user-defined files on up to two PCMCIA-based Flash memory cards.
Flash boot ROM	512 KB	1	Flash EPROM for the ROM monitor program boot image.

1. 64 MB of DRAM is the default DRAM configuration for the GRP.
2. SRAM is *not* able to be upgraded or configured.
3. NVRAM is *not* able to be upgraded or configured.
4. SIMM socket is wired for a Cisco design and does not accept industry-standard 80-pin Flash SIMMs.
5. 20-MB Flash memory card is the default shipping configuration for the Cisco 12404 Internet router.

The Cisco IOS software images that run the Cisco 12404 router reside in Flash memory, which is located on the GRP in the form of a single in-line memory module (SIMM), and on up to two (PCMCIA) cards (called *Flash memory cards*) that insert in the two PCMCIA slots on the front of the GRP. Storing the Cisco IOS images in Flash memory enables you to download and boot from upgraded Cisco IOS images remotely or from software images resident in GRP Flash memory.

The Cisco 12404 router supports system software downloads for most Cisco IOS software upgrades, which enables you to remotely download, store, and boot from a new Cisco IOS image. See Figure A-2.

DRAM

The EDO DRAM on the GRP stores routing tables, protocols, and network accounting applications; it also runs the Cisco IOS software. The default GRP DRAM configuration is 64 megabytes of EDO DRAM, which you can increase up to 256 MB through DRAM upgrades. The Cisco IOS software runs from within GRP DRAM. Table A-5 lists the DRAM configurations and upgrades.

Caution To prevent memory problems, DRAM DIMMs must be 3.3-volt, 60-nanosecond devices. Do not attempt to install other devices in the DIMM sockets.

Table A-5 DRAM Configurations

Total DRAM	Product Numbers	DRAM Sockets	Number of DIMMs
64 MB[1]	MEM-GRP/LC-64(=)	U39 (bank 1)	One (1) 64-MB DIMM
128 MB	MEM-GRP/LC-64(=)	U39 (bank 1) and U42 (bank 2)	Two (2) 64-MB DIMMs
128 MB	MEM-GRP/LC-128(=)	U39 (bank 1)	One (1) 128-MB DIMM
256 MB	MEM-GRP/LC-256(=)	U39 (bank 1) and U42 (bank 2)	Two (2) 128-MB DIMMs

1. 64 MB of DRAM is the default DRAM configuration for the GRP.

SRAM

The SRAM provides secondary CPU cache memory. The standard GRP configuration is 512 KB. The principle function of SRAM is to act as a staging area for routing table update information to and from the line cards. SRAM is *not* able to be upgraded or configured.

NVRAM

The system configuration, software configuration register settings, and environmental monitoring logs are contained in the 512-KB NVRAM, which is backed up with built-in lithium batteries that retain the contents for a minimum of 5 years. NVRAM is *not* able to be upgraded or configured

Caution Before you replace the GRP in the system, back up the running configuration to a Trivial File Transfer Protocol (TFTP) file server or an installed Flash memory card so you can retrieve it later.

If the configuration is not saved, the entire configuration is lost inside the NVRAM on the removed GRP and you must re-enter the entire configuration manually.

This procedure is not necessary if you are temporarily removing a GRP; lithium batteries retain the configuration in memory until you replace the GRP in the router.

Flash Memory

Both the onboard and PCMCIA card-based Flash memory allow you to remotely load and store multiple Cisco IOS software and microcode images. You can download a new image over the network or from a local server and then add the new image to Flash memory or replace the existing files. You can then boot the routers either manually or automatically from any of the stored images. Flash memory also functions as a TFTP server to allow other servers to boot remotely from stored images or to copy them into their own Flash memory.

PCMCIA Slots

The GRP has two PCMCIA slots. Either slot can support a Flash memory card or an input/output (I/O) device as long as the device requires only +5 VDC.

LED Types

Table A-6 describes the types of system status light emitting diodes (LED) used on the GRP.

Table A-6 System Status LED Types, Description, and Power Source

LEDs	Description and Power Source
2 PCMCIA	Activity LEDs (one per PCMCIA slot) light when the slot is accessed. The LEDs receive power from the switched slot voltage.
4 RJ-45	Ethernet port LEDs are used in conjunction with the RJ-45 Ethernet connector. The LEDs indicate link activity, collision detection, data transmission, and data reception. When the MII Ethernet port is in use, the LEDs are disabled.
2 RJ-45 or MII	Ethernet port select LEDs when on, identify which one of the two Ethernet connections you selected. When the RJ-45 port is selected, its LED is on and the MII LED is off. When the MII port is selected, its LED is on and the RJ-45 LED is off.
Alphanumeric displays	These alphanumeric LED displays are controlled directly by the MBus and provide information about the system status during the boot process. Alphanumeric displays are organized as two rows of four characters each. The displays' content is controlled by the MBus module software. Both rows of the display are powered by the MBus module. After the boot process, the LEDs are controlled by Cisco IOS software through the MBus, and display messages designated by Cisco IOS software.

Asynchronous Serial Ports

Two asynchronous serial ports on the GRP, the console and auxiliary ports, allow you to connect external devices to monitor and manage the system.

The consoleport is an Electronics Industries Association/Telecommunications Industry Association (EIA/TIA)-232 receptacle (RS-232 female) that provides a data circuit-terminating equipment (DCE) interface for connecting a console terminal.

Note EIA/TIA-232 was known as recommended standard RS-232 before its acceptance as a standard by the EIA/TIA.

The auxiliary port is an EIA/TIA-232 plug (male) that provides a data terminal equipment interface. The auxiliary port supports flow control and can be used to connect a modem, a channel service unit (CSU), or other optional equipment for Telnet management.

Ethernet Port

The GRP has one Ethernet port available, using one of the following two connection types:

- RJ-45 receptacle—An 8-pin media dependent interface (MDI) RJ-45 receptacle for either IEEE 802.3 10BASE T (10 Mbps) or IEEE 802.3u 100BASE TX (100 Mbps) Ethernet connections.
- MII receptacle—A 40-pin media independent interface (MII) receptacle that provides additional flexibility in Ethernet connections. The pinout of this standard 40-pin receptacle is defined by the IEEE 802.3u standard.

Note The RJ-45 and MII receptacles on the GRP represent two physical connection options for one Ethernet interface; therefore, you can use either the MDI RJ-45 connection or the MII connection, but not both at the same time.

Performance Route Processor

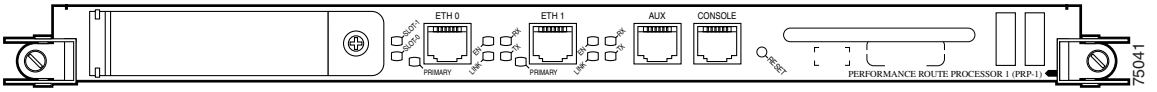
This section provides an overview of the PRP (Figure A-3) and its use as the main system processor for the Cisco 12404 router.

This section provides information on the following PRP functionality.

- PRP memory
- System status LEDs
- Soft reset switch
- PCMCIA slots

- Asynchronous serial ports

Figure A-3 Performance Route Processor



The following are primary functions of the PRP.

- Loading the Cisco IOS software to all of the installed line cards at power on
- Providing a console (terminal) port for router configuration
- Providing an auxiliary port for other external equipment (such as modems)
- Providing an IEEE 802.3, 10/100-megabit-per-second (Mbps) Ethernet port for Telnet functionality
- Running routing protocols
- Building and distributing routing tables to the line cards
- Providing general system maintenance functions for the Cisco 12404 router.

The PRP communicates with the line cards either through the CSF or through the maintenance bus (MBus). The CSF connection is the main data path for routing table distribution as well as for packets that are sent between the line cards and the PRP.

The MBus connection allows the PRP to download a system bootstrap image, collect or load diagnostic information, and perform general, internal system maintenance operations. The PRP plugs into any slot in the card cage in the Cisco 12404 router. The router is shipped with 20MB of Flash memory as the default configuration.

PRP Memory

Memory components of the PRP are listed in Table A-7.

Table A-7 PRP Memory Components

Type	Size	Quantity	Description
SDRAM[1]	512 MB, 1 GB, or 2 GB	1 or 2	512-MB or 1-GB DIMMs (based on SDRAM required) for main Cisco IOS software functions.
SRAM[2]	2 MB (fixed)		Secondary CPU cache memory functions.
NVRAM[3]	2 MB (fixed)	1	Nonvolatile random-access memory (NVRAM) for the system configuration file.
Flash Memory	64 MB SIMM[4]	1	Contains Cisco IOS software images and other user-defined files on the PRP.
Flash Memory (card)	20 MB[5]	Up to 2	Contains Cisco IOS software images and other user-defined files on up to two PCMCIA-based Flash memory cards.
Flash boot ROM	512 KB	1	Flash EPROM for the ROM monitor program boot image.

1. Default SDROM configuration is 512 MB. Bank 1 (U15) must be populated first. You can use one or both banks to configure SDRAM combinations of 512 MB, 1 GB, or 2 GV. 1.5-GB configurations are not supported.
2. SRAM is not user configurable or field replaceable.
3. NVRAM is not user configurable or field replaceable.
4. Flash memory SIMM is not user configurable or field replaceable.
5. ATA Flash disks, and Type I and Type II linear Flash memory cards are supported.

The Cisco IOS software images that run the Cisco 12404 router reside in Flash memory, which is located on the PRP in the form of a single in-line memory module (SIMM), and on up to two (PCMCIA) cards (called *Flash memory cards*) that insert in the two PCMCIA slots on the front of the PRP. Storing the Cisco IOS images in Flash memory enables you to download and boot from upgraded Cisco IOS images remotely or from software images resident in PRP Flash memory.

The Cisco 12404 router supports system software downloads for most Cisco IOS software upgrades, which enables you to remotely download, store, and boot from a new Cisco IOS image. See Figure A-3.

SDRAM

SDRAM—The SDRAM on the PRP stores routing tables, protocols, and network accounting applications; it also runs the Cisco IOS software. The default PRP configuration includes 512 MB of error checking and correction (ECC) SDRAM. DIMM upgrades of 512 MB and 1 GB are available. You cannot mix memory sizes. If two DIMMS are installed, they must be the same memory size. Supported memory configurations are listed in Table A-8.

Caution Cisco strongly recommends that you use only Cisco-approved memory. To prevent memory problems, SDRAM DIMMs must be +3.3VDC, PC133-compliant devices. Do not attempt to install other devices in the DIMM sockets.

Table A-8 Supported PRP Route Memory Configurations

Total Route Memory	Cisco Product Number	DIMM Modules
512 MB[1]	—	1 512-MB DIMM
1 GB	MEM-PRP-512=[2]	2 512-MB DIMMs
1 GB	MEM-PRP-1G=	1 1-GB DIMM
1.5 GB[3]	—	—
2 GB	NA	2 1-GB DIMMs

1. One 512-MB DIMM is the default shipping configuration.
2. Upgrades PRP to 1 GB by adding a second 512-MB DIMM.
3. This memory size is not supported.

SRAM

The SRAM provides secondary CPU cache memory. The standard PRP configuration is 2 MB. The principle function of SRAM is to act as a staging area for routing table update information to and from the line cards. SRAM is *not* able to be upgraded or configured.

NVRAM

The system configuration, software configuration register settings, and environmental monitoring logs are contained in the 2 MB NVRAM, which is backed up with built-in lithium batteries that retain the contents for a minimum of five years. NVRAM is *not* able to be upgraded or configured

Caution Before you replace the PRP in the system, back up the running configuration to a Trivial File Transfer Protocol (TFTP) file server or an installed Flash memory card so you can retrieve it later.

If the configuration is not saved, the entire configuration will be lost inside the NVRAM on the removed PRP and you will have to reenter the entire configuration manually.

This procedure is not necessary if you are temporarily removing a PRP; lithium batteries retain the configuration in memory until you replace the PRP in the router.

Flash Memory

Both the onboard and PCMCIA card-based Flash memory allow you to remotely load and store multiple Cisco IOS software and microcode images. You can download a new image over the network or from a local server and then add the new image to Flash memory or replace the existing files. You can then boot the routers either manually or automatically from any of the stored images. Flash memory also functions as a TFTP server to allow other servers to boot remotely from stored images or to copy them into their own Flash memory.

Table A-9 lists the supported Flash disk sizes and their Cisco product numbers.

Table A-9 Supported Flash Disk Sizes and Product Numbers

Flash Disk Size[1]	Product Number
64 MB[2]	MEM-12KRP-FD64=
128 MB	MEM-12KRP-FD128=
1 GB	MEM-12KRP-FD1G=

1. Standard Type 1 and Type 2 linear Flash memory cards also are supported, although they may not have the capacity to meet the requirements of your configuration.
2. 64-MB ATA Flash disk is the default shipping configuration.

PCMCIA Slots

The PRP has two PCMCIA slots. Either slot can support a Flash memory card or an input/output (I/O) device as long as the device requires only +5 VDC.System Status LEDs

LED Types

Table A-10 lists system status light emitting diodes (LED) used on the PRP.

Table A-10 System Status LED Types, Description, and Power Source

LEDs	Description and Power Source
2 PCMCIA	Activity LEDs (one per PCMCIA slot) light when the slot is accessed. The LEDs receive power from the switched slot voltage.
4 RJ-45	Ethernet port LEDs are used in conjunction with the RJ-45 Ethernet connector. The LEDs indicate link activity, port enabled, data transmission, and data reception.
2 Ethernet connection	The Ethernet connection LEDs (labeled Primary), when on, identify which of the two Ethernet connections is selected. Because both ports are supported on the PRP, the LED on port ETH0 is always on. The ETH1 LED goes on when it is selected.
Alphanumeric displays	The alphanumeric LED displays are controlled directly by the MBus and provide information about the system status during the boot process. Alphanumeric displays are organized as two rows of four characters each. The displays' content is controlled by the MBus module software. Both rows of the display are powered by the MBus module. After the boot process, the LEDs are controlled by the Cisco IOS software through the MBus, and display messages designated by the Cisco IOS software.

Asynchronous Serial Ports

The PRP has two asynchronous serial ports, the console and auxiliary ports. These allow you to connect external serial devices to monitor and manage the system. Both ports use RJ-45 receptacles.

The console port provides a data circuit-terminating equipment (DCE) interface for connecting a console terminal. The auxiliary port provides a data terminal equipment (DTE) interface and supports flow control. It is often used to connect a modem, a channel service unit (CSU), or other optional equipment for Telnet management.

Ethernet Port

The PRP includes two Ethernet ports, both using an 8-pin RJ-45 receptacle for either IEEE 802.3 10BASE-T (10 Mbps) or IEEE 802.3u 100BASE-TX (100 Mbps) connections.

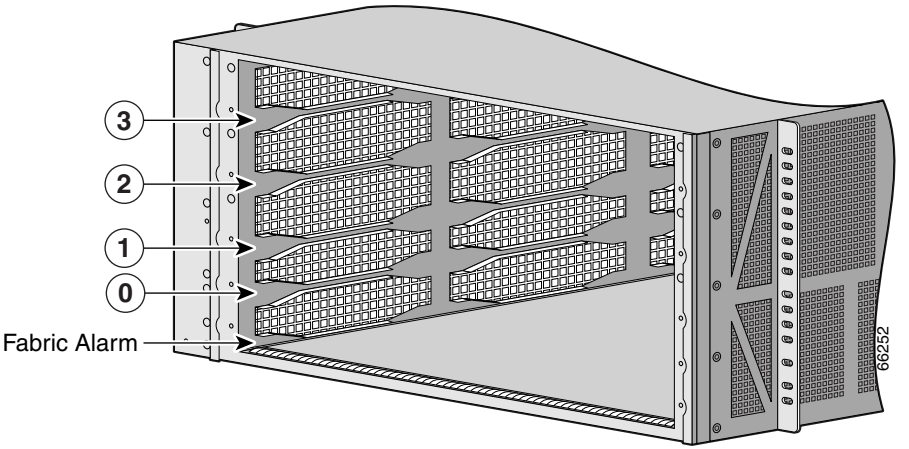
Note The transmission speed of the Ethernet ports is auto-sensing by default and is user configurable.

Line Cards

The Cisco 12404 router is shipped with up to 3 installed line cards that provide a variety of network media types (based on the order). The line cards can be installed in slots 0 through 3 in the line card cage and interface to each other and to the RP through the CSF (Figure A-4). Horizontal cable-management brackets attach to each line card to manage and organize the network interface cables.

Note Slot 0 (zero) is one slot above the slot labeled Fabric Alarm.

Figure A-4 RP and Line Card Slot Numbers and CSF Location



Line cards installed in the Cisco 12404 router support online insertion and removal, which means you can remove and replace (hot-swappable) a line card while the router remains powered on.

Caution To ensure adequate airflow through the card cage, empty card slots must have a card blank installed.

Consolidated Switch Fabric Status

An OK/Fail pair of LEDs are provided to indicate the status of the Alarm MBus and Fabric MBus. The green light indicates that the MBus module is operating properly. The Fail light indicates that the MBus has detected some error, in itself, or with the MBus power supply.

Power Entry Module Monitoring

The CSF and alarm card provides monitoring of the PEM. Table A-11 provides alarm definitions.

Table A-11 CSF and Alarm Monitoring Status Definitions

Status	Definition
Power Fail	Power is not being provided to the power supply
Power Fault	A fault exists in the power supply
Missing Module	One of the PEMs is not present
Voltage Monitor	A voltage monitor signal in the range of 0 to 4.096 V is provided to the MBus controller to measure the power supply output voltage level
Current Monitor	A current monitor signal in the range of 0 to 4.096 V is provided to the MBus controller to measure the power supply output current level.

P8 Alarm Relay Contact Connector

This connector is a standard DB-9 connector. The relay interface is rated at max 2A, 60V or 50VA, whichever is greater.

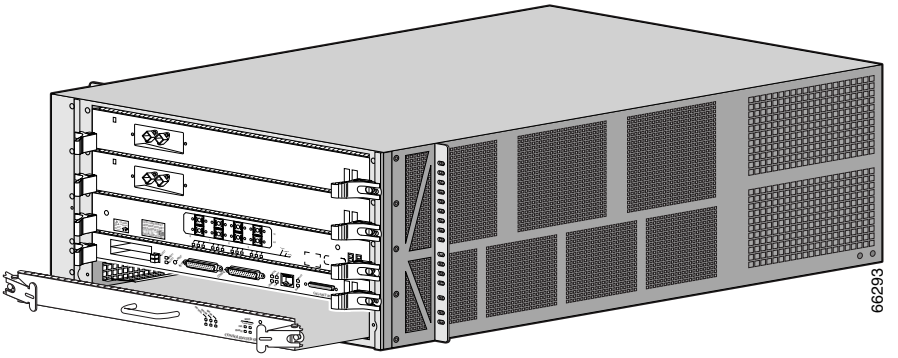
MBus Module Port Pin Assignments

Twenty general purpose pins and four analog input pins on the MBus module are used for this design.

CSF Functionality

The CSF circuity provides synchronized speed interconnections for the line cards and the RP (Figure A-5). The CSF circuitry consists of clock and scheduler, and switch fabric functionality; is contained on one card, housed in the bottom slot in the chassis. The CSF card has a switching capacity of 40 Gbps.

Figure A-5 CSF Card Slot



Clock and Scheduler Functionality

The CSF card generates and distributes system-wide clock and cell time synchronization signaling. System clock generation is delivered to the system via the backplane and local clock functions are derived from the system clock.

System Clock

The system clock synchronizes data transfers between line cards or between the RP and a line card through the CSF. The system clock signal is sent to all line cards and the RP.

Scheduler

The scheduler handles requests from the line cards for access to the CSF. When the scheduler receives a request from a line card for CSF access, the scheduler determines when to allow the line card access to the CSF.

Switch Fabric

Switch fabric circuitry carries the user traffic between line cards or between the RP and the line cards.

Power Entry Modules

The Cisco 12404 router chassis supports two 1100 W online insertion and removal hot swappable PEMs. Each unit is capable of delivering up to 1100 W at –54.5 VDC. The router PEMs are hot swappable and the router must be populated with two PEMs to meet EMI standards.

Caution Do not mix PEM types in the router. In multiple PEM system configurations, all PEMs must be of the same type; either all AC PEMs for AC powered routers, or all DC PDUs and DC PEMS for DC powered routers.

A hardwired DC power source, power cable is required from the site DC power source to the DC PDU on the chassis. The DC power cable leads are 4 American Wiring Gauge (AWG) high strand count wire.

For detailed handling and replacement instructions for the Cisco 12404 router PEMs, see the appropriate configuration note which accompanies each AC PEM, DC PEM, or DC PDU that is shipped from the factory as a FRU.

AC Power Entry Module

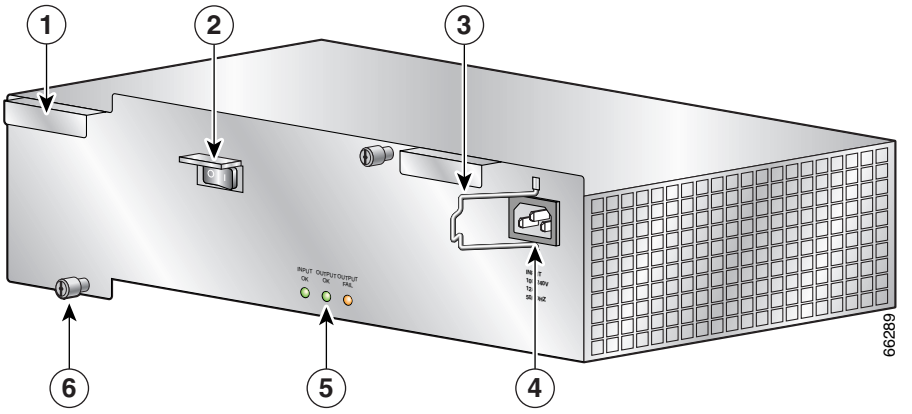
The AC PEM (Figure A-6) measures 6.60 inches (16.76 cm) deep by 14.30 inches (36.32 cm) wide by 3.50 inches (8.89 cm) high and weighs 11.0 lbs (5.0 kg).

The router is configured to customer specifications from the factory. If 1 AC PEM is requested, 2 AC PEMs are shipped.

Connect each AC PEM to a separate AC power source.

A power factor corrector (PFC) allows the PEM to accept AC power source voltage from an AC power source nominally operating between 100 to 120 VAC, 15-Amp service in North America; and a range of 185 to 264 VAC, 10-Amp service, in an international environment.

Figure A-6 AC PEM



1	AC PEM handle	**4**	Power cord receptacle
2	On/Off switch	**5**	LEDs
3	Bail Latch	**6**	Captive screws

A 14 ft. (4.3 m) AC power cord is supplied to connect the AC PEM to the power source.

Note Install an uninterruptable power source (UPS) as a safeguard against power loss.

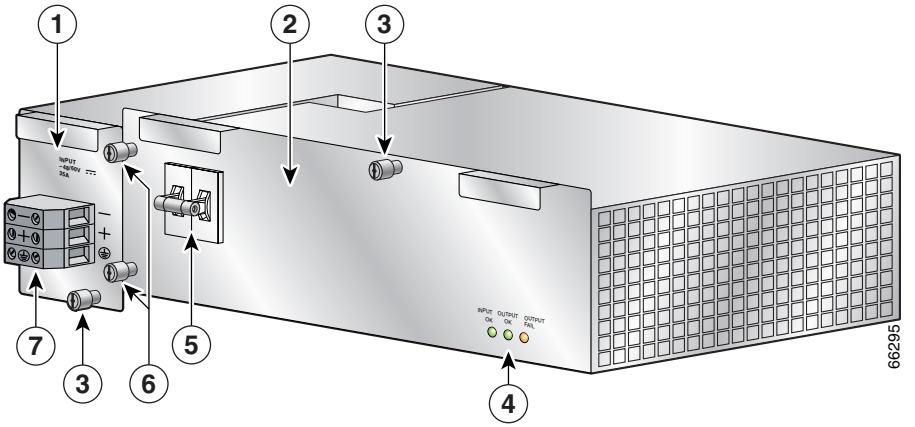
DC Power Entry Module

The DC PEM and DC PDU is a 2-part unit, which measures 6.60 inches (16.76 cm) deep by 14.30 inches (36.32 cm) wide by 3.50 inches (8.89 cm) high and weighs 14.0 lbs (6.35 kg). Refer to Figure A-7.

A PFC allows the PEM to accept DC power source voltage from an AC power source operating between 100 to 120 VAC, 15-Amp service in North America; and a range of 185 to 264 VAC, 10-Amp service in an international environment.

Note Attach each DC PDU be connected to an independent power source for full redundancy. Use an uninterruptable power source (UPS) to protect against power failures at your site.

Figure A-7 DC Power PEM and PDU Assembly



1	DC PDU	**5**	On/Off switch
2	DC PEM	**6**	PDU captive screws
3	PEM captive screws	**7**	Terminal block
4	LEDs		

Each DC PDU should be connected to separate DC sources using six threaded terminals. Two terminals for negative (source DC), two terminals for positive (source DC return), and two terminals for ground. The DC power cable leads should be 4 American Wiring Gauge (AWG) high strand count wire. The PEM accepts DC power source voltage from a dedicated 45–Amp service DC power source operating between -48 to -60 VDC nominal input voltage and -40 to -72 VDC steady-state input voltage.

Caution The DC PEM and DC PDU assembly weighs 14.0 pounds (6.35 kg.). Use two hands when handling the power supply.

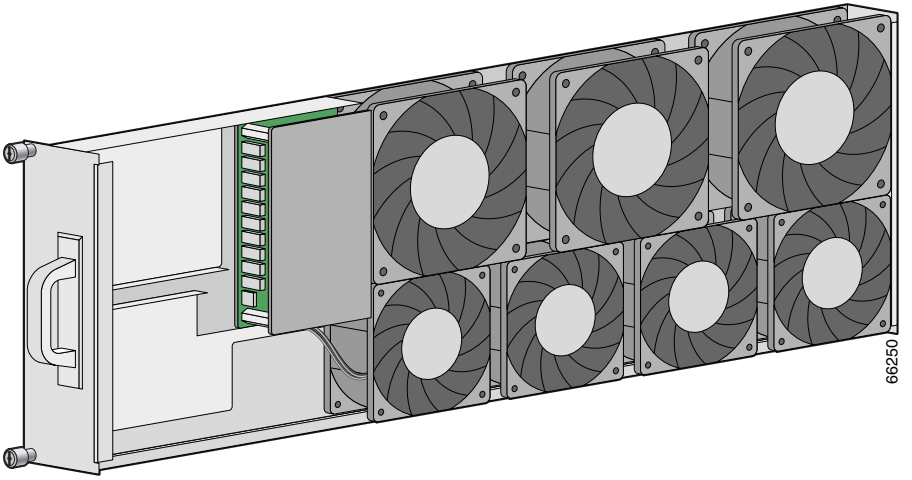
Warning **Power to your router must be Off and all cables disconnected before you connect the DC PDU. The DC PDU is not a hot-swappable, field replaceable unit.**

Fan Tray Assembly

The Cisco 12404 router has one fan tray (Figure A-8). Facing the rear of the chassis the fan tray assembly is located on the right side of the chassis. The fan tray assembly maintains acceptable operating temperatures for the internal components by drawing cooling air through the card cages from side to side.

The fan tray assembly is a sheet metal enclosure containing seven fans and two fan controller cards.

Figure A-8 Fan Tray Assembly

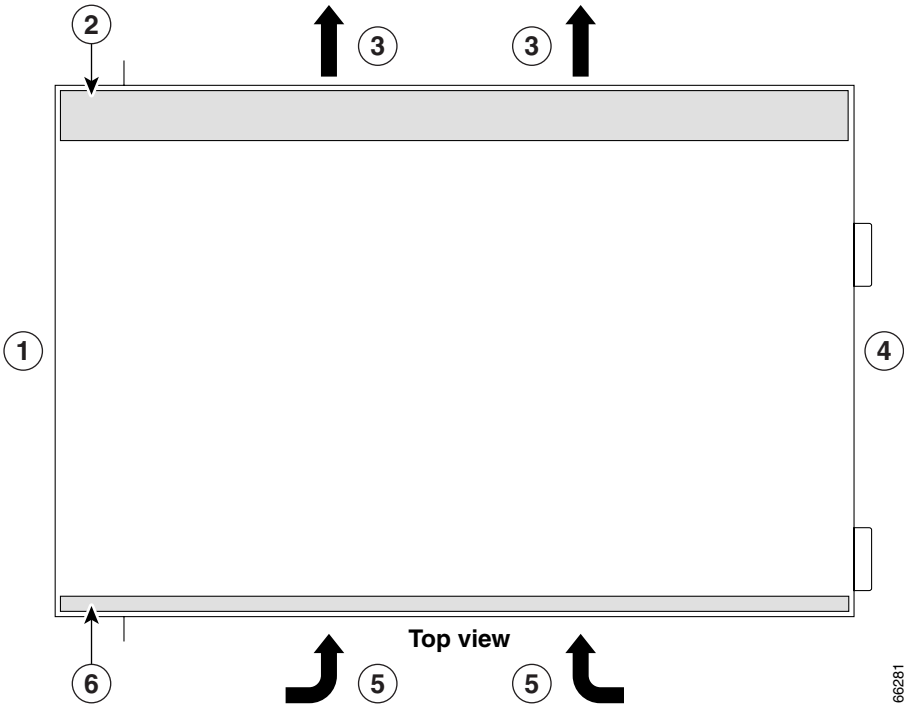


Warning **Allow sufficient air flow by maintaining 6 inches (15.24 cm) of clearance at both the inlet and exhaust openings on the chassis because exhaust from other equipment vented directly into the router air inlet may cause an over-heat condition.**

The fans draws room air in through an air filter on the opposite side of the chassis. See Figure A-9. The fans draw air through the card cage and out through exhaust vents on the opposite side of the chassis.

The front, back and sides of the Cisco 12404 router must remain unobstructed to ensure adequate air flow and prevent overheating inside the RP and line card cage. We recommend at least 6 inches (15.2 centimeters) of clearance on all sides.

Figure A-9 Internal Air Flow—Top View



If the air temperature inside the RP and line card cage rises the system environmental monitor shuts down all internal power to prevent equipment damage from excessive heat.

If the system detects that one of the fans within the fan tray assembly has failed, it displays a warning message on the console screen. If multiple fans fail, the system will shut down to prevent equipment damage.

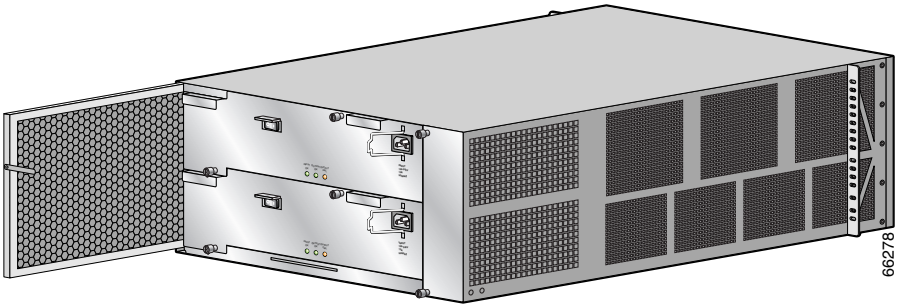
A handle on the fan tray assembly provides a grip point for removing and replacing the fan tray.

Air Filter

The Cisco 12404 router is equipped with one serviceable air filter. As you face the rear of the chassis, the air filter is housed on the left side of the chassis in a narrow vertical slot.

Do not run the Cisco 12404 router without the air filter installed. You should inspect and clean the air filter once a month (more often in dusty environments). Procedures for vacuuming and replacing the air filter are contained in the section "Cleaning and Replacing the Air Filter, page 5-25" in Chapter 5. A copy of the air filter replacement instructions is shipped with the air filter when ordered as an FRU, *Cisco 12404 Internet Router Air Filter Replacement Instructions*, document Part No. 78-13621-01. Figure A-10 shows the location of the air filter.

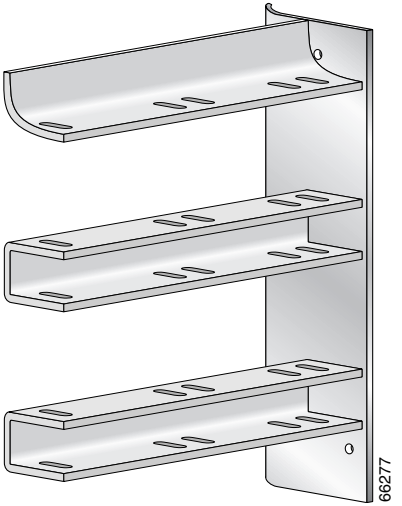
Figure A-10 Cisco 12404 Internet Router Air Filter Location



Chassis Cable-Management System

The Cisco 12404 Internet router chassis cable-management system organizes the interface cables entering and exiting the system, keeping them free of sharp bends (excessive bending in an interface cable can cause performance degradation) and out of the way. See Figure A-11.

Figure A-11 Chassis Cable Management System



Maintenance Bus

The Cisco 12404 Internet router maintenance bus and MBus modules manage all of the maintenance functions of the system.

The MBus consists of two separate busses (providing MBus redundancy) that link all of the line cards, the RP, the CSF , the power supplies, and the fan tray. Each component contains an MBus module that allows the component to communicate over the MBus. The MBus module on each component is powered by +5 VDC

directly from the power supply and performs the functions of power-up/down control, device discovery, code download, diagnostics, and environmental monitoring and alarms.

Power-On/Off Control

Based on commands it receives from its on-board EPROM and from the master RP, each MBus module directly controls the DC-DC converters on the component to which it is mounted. Each MBus module is tied directly to +5 VDC from the power supply. When power is applied to the Cisco 12404 Internet router, all MBus modules immediately power on. The MBus modules on the RP or CSF immediately turn on the DC-DC converter, powering up the respective card. The line card MBus module waits to power on the line card until it receives a command from the master RP.

- Device discovery—The RP can determine the system configuration using the MBus. A message is sent from the RP over the MBus requesting all installed devices to identify themselves. The response back provides slot number, card and component type.
- Code download—A portion of the line card operating software can be downloaded from the RP to the line card over the MBus. Because the MBus is relatively slow compared to the CSF, only enough code is downloaded to the line card for it to access the CSF and complete the download process.
- Diagnostics—The diagnostic software image is downloaded from the RP to the card under test.
- Environmental Monitoring and Alarms—The MBus module on each component monitors that component's environment as follows:
  - Line cards and the RP are monitored for temperature by two temperature sensors mounted on each card. The MBus module makes voltage adjustments through software for the +2.5, +3.3, and +5 VDC DC-DC converters.
  - The CSF is monitored for temperature by two temperature sensors mounted on each card. The MBus module makes voltage adjustments through software for the +2.5, +3.3, and +5 VDC DC-DC converters.
  - Environmental monitoring includes voltage monitoring, temperature monitoring, fan tray assembly and rotational sensing for each fan in the fan tray.